

= 211
 Ave. = 22.3/25.

2

THIRD EXAM

Name (print) MING ZHANG Name (signed) Solution.

Discussion Instructor (circle one): Cady McAllister Molina Stone

Discussion Section #: _____

SHOW ALL WORK!!!!

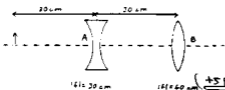
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!

Use the conversion constants and data given on the front page.

An object is placed 30 cm in front of lens A.

- Calculate the position of the final image as a distance along the optic axis from lens B. State clearly whether the final image is right or left of lens B.
- State whether the final image in (a) is erect or inverted and justify your choice.
- If the original object is 1.00 cm high, what is the size of the final image?
- State clearly and give your reason whether the final image is real or virtual.

NOTE: Signs are important in this problem and sign errors will not be treated as "trivial." In (a) and (c), no credit if a reason for your answer is not given.



(a) $f_A = -30 \text{ cm}$, $f_B = 60 \text{ cm}$,
 $\frac{1}{s_A} + \frac{1}{s'_A} = \frac{1}{f_A} \Rightarrow s'_A = 30 \text{ cm}$

$s'_A = \left(\frac{1}{f_A} - \frac{1}{s_A}\right)^{-1} = \boxed{-15.0 \text{ cm}}$
 on the left of lens A

$s_B = |s'_A| + 30 \text{ cm} = 15 + 30 = 45 \text{ cm}$

$\frac{1}{s_B} + \frac{1}{s'_B} = \frac{1}{f_B} \Rightarrow s'_B = \left(\frac{1}{f_B} - \frac{1}{s_B}\right)^{-1} = \boxed{-180 \text{ cm}}$
 minus sign: on the left of lens B } +5 points

(b) $M = M_A \cdot M_B = \left(-\frac{s'_A}{s_A}\right) \cdot \left(-\frac{s'_B}{s_B}\right) = \frac{1}{2} \times 4 = \boxed{2.00}$
 positive sign: the image is erect. } +5 points

(c) +5 points $M = \frac{h_{\text{image}}}{h_{\text{obj}}} \Rightarrow h_{\text{image}} = M \times h_{\text{obj}} = 2 \times 1.00 \text{ cm} = \boxed{2.00 \text{ cm}}$

(d) Since the final image distance is a negative number ($s'_B = -180 \text{ cm}$), the final image is virtual.
+5 points